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THE USE OF MATLAB IN DEVELOPING THE SIMULATION OF THE VOLTAGE DIVIDER TO BE IMPLEMENTED AS A MEDIA OF TEACHING IN CLASS THAT HAS ADOPTED ALFHE (ACTIVE LEARNING FOR HIGHER EDUCATION) TEACHING STRATEGY[9][10][11][12][13][14]

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ABSTRACT

On this occasion, the author discusses the use of MATLAB programming to simulate the principle of the voltage divider and its circuit analysis. This simulation can be used as a media of teaching to support the implementation of ALFHE (Active Learning for Higher Education) teaching strategy [10]. Voltage divider circuits discussed in this article consists of a DC source voltage (Direct Current) of 10 Volts, and two resistors. The first resistor called R1 and the second one is a variable resistor and called R2. The author will show that the voltage measured on R2 would be close enough to the value of the source voltage if the value of R2 is much greater than R1 (R2≥R1). The author will also show that the value of R2 = 10 X R1 will make the voltage across R2 to be about 90.91% of the source voltage value.

KEYWORDS: Voltage, MATLAB, Voltage Divider Circuits

INTRODUCTION

The principle of the voltage divider is used extensively in some subjects; Electrical, Electronics, and Digital [1][6]. Understanding the principle of a voltage divider will help the students to study more deeply the three branches of sciences mentioned before. In conducting this teaching process many of the teaching participants (Teacher / Lecturer, Students) have difficulty in developing a learning media that will facilitate them (Teacher / Lecturer) to implement the developed learning strategy, and the student to comprehend the subjects more easily. The authors hope this article will help the teachers or the lecturers to teach and make it easier for student to grasp the principle of the voltage divider [9], Hopefully this simulation can be used by class participants as a one of media of teaching in class that adopted ALFHE strategies [10][11][12][13][14].

MainFigure 1 below shows the circuits of the voltage divider.

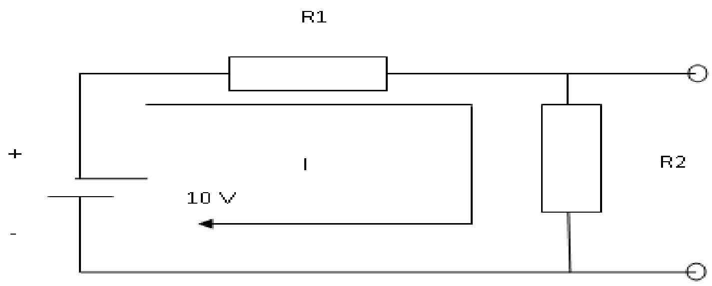

Figure 1: Voltage Divider[9]

According to ohm's law, the voltage is the result of multiplying the value of the resistance and the value of the current flowing through it. Or it can be written in the form of mathematical equation as follows [2] [3] [4] [5],

$$V = I \times R \quad \text{.......................} \quad (1)$$

The unit for voltage is volt (V), and the unit for the current is ampere (A). The equation for current is given by:

$$I = V / R \quad \text{.........................} \quad (2)$$

And for the resistance (R) with unit ohm (Ω) is obtained by dividing the drop voltage V (volts) across it and currents I (Ampere) flowing through (Volt / Ampere) it as shown below,

$$R = V / I \quad \text{............................} \quad (3)$$

According to equation 1 and Figure 1 we can replace figure 1 to figure 2 as shown below,

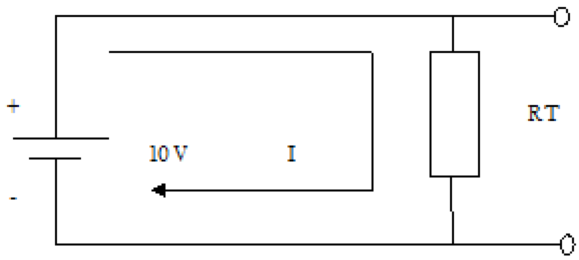

Figure 2[9]

From Figure 2 we can see the value of current (I) is given by equation 4 below,

$$I = V / RT \quad \text{..........................} \quad (4)$$

From Figure 2 above, we can conclude that the value of RT is given in Equation 5 below,

$$RT = R1 + R2 \quad \text{......................} \quad (5)$$

In this article the focus of the discussion is to simulates the voltage drop on R2 by using MATLAB and to prove that when R2 >> R1 then the voltage drop across R2 will be close enough to the value of the source voltage (10 volts) and if we put R2 = 10 x R1, the value of the voltage across R2 will increase significantly to the value of the voltage source 10 Volt.

From Kirchhoff's law we know also that [8]

$$V - VR1 - VR2 = 0 \quad \text{...............} \quad (6)$$

Or can be rewritten as shown in Equation 7 below,

$$V = VR1 + VR2 \quad \text{...................} \quad (7)$$

There are various ways to obtain the voltage across R2 (VR2), by re-arrange equation 7; we obtain equation 8 as written below

$$VR2=V-VR1\ldots\ldots\ldots\ldots\ldots(8)$$

Or by using equation 9 given below

$$VR2=I\ X\ R2\ldots\ldots\ldots\ldots\ldots(9)$$

From equation 9, 4, and 5 we can obtain equation 10 as given below,

$$VR2=\frac{V}{R1+R2}X\ R2\ldots\ldots\ldots\ldots\ldots(10)$$

Equations 8 and 10 are essentially identical but for simulation on this occasion the author will use equation 10 on MATLAB [7].

By using equations 10 and create a table using Microsoft Excel we obtained Table 1 as shown below,

Table 1: Simulation Result[9]

R1(K Ohm)	R2 (K Ohm)	Vin (Source Voltage) (DC)	Vout (VR2) Volt	%Vout/Vin
1	0	10	0	0
1	1	10	5	50
1	2	10	6,666666667	66,66666667
1	3	10	7,5	75
1	4	10	8	80
1	5	10	8,333333333	83,33333333
1	6	10	8,571428571	85,71428571
1	7	10	8,75	87,5
1	8	10	8,888888889	88,88888889
1	9	10	9	90
1	10	10	9,090909091	90,90909091
1	11	10	9,166666667	91,66666667
1	12	10	9,230769231	92,30769231
1	13	10	9,285714286	92,85714286
1	14	10	9,333333333	93,33333333
1	15	10	9,375	93,75
1	16	10	9,411764706	94,11764706
1	17	10	9,444444444	94,44444444
1	18	10	9,473684211	94,73684211
1	19	10	9,5	95
1	20	10	9,523809524	95,23809524
1	21	10	9,545454545	95,45454545
1	22	10	9,565217391	95,65217391
1	23	10	9,583333333	95,83333333
1	24	10	9,6	96
1	25	10	9,615384615	96,15384615
1	26	10	9,62962963	96,2962963
1	27	10	9,642857143	96,42857143
1	28	10	9,655172414	96,55172414
1	29	10	9,666666667	96,66666667
1	30	10	9,677419355	96,77419355
1	31	10	9,6875	96,875
1	32	10	9,696969697	96,96969697
1	33	10	9,705882353	97,05882353
1	34	10	9,714285714	97,14285714
1	35	10	9,722222222	97,22222222

Table 1: Contd.,

1	36	10	9,72972973	97,2972973
1	37	10	9,736842105	97,36842105
1	38	10	9,743589744	97,43589744
1	39	10	9,75	97,5
1	40	10	9,756097561	97,56097561

By using MATLAB and enter the following commands in the Command Window

```
>>R1=1;R2=0:1:40;Vin=10;VR2=Vin.*(R2./(R1+R2));VR1=Vin-VR2;figure;plot(R2,VR2,R2,VR1);
h=legend('VR2','VR1');xlabel('R2');ylabel('Voltage');grid on;title('R2 vs VR2 and VR1')
```

We obtained simulations graph as shown in Figure 3 below,

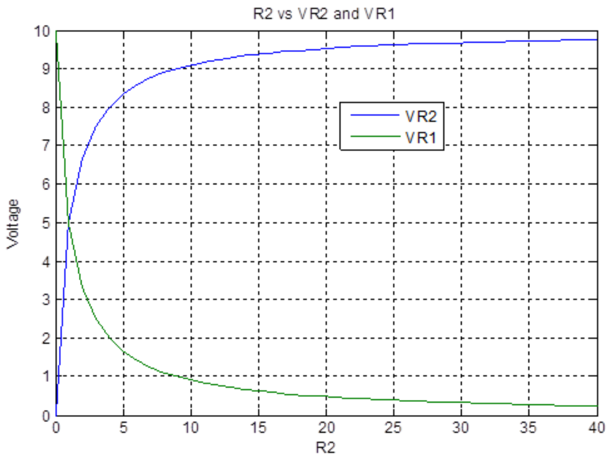

Figure 3: Graph 1 Simulation Result[9]

CONCLUSIONS

From table 1 and the graph1 of figure 3 above, we can take some conclusions,

- The output voltage will be equal to 0 if R2 = 0 ohms
- The output voltage will be higher if the value of R2 is increased
- The output voltage will be close to the voltage source (90.9% of the voltage source) if R2 = 10 X R1
- The voltage across R1 and R2 will be equal if R1=R2
- The output voltage will be almost equal to the voltage source if R2 >> R1
- The sum of voltage across R1 and R2 will be equal to the source voltage (10V)

Closing

This article is expected to contribute to science, especially in the fields of computer, Electricity, Electronics, and Digital. And also can be used as a media of teaching on those fields especially classes that adopted ALFHE teaching strategy; expected to assist teachers and learners to be able to carry out the teaching and learning process much better [9].

REFERENCES

1. http://elektronika-dasar.com/teori-elektronika/pembagi-tegangan-voltage-divider/
2. http://www.allaboutcircuits.com/vol_1/chpt_2/1.html
3. http://en.wikipedia.org/wiki/Ohm's_law
4. http://www.the12volt.com/ohm/ohmslaw.asp
5. http://phet.colorado.edu/en/simulation/ohms-law
6. http://en.wikipedia.org/wiki/Voltage_divider
7. http://bungaliani.wordpress.com/2010/11/12/tips-microsoft-excel-membuat-grafik-untuk-kolom-yang-berbeda/
8. http://physics.about.com/od/electromagnetics/f/KirchhoffRule.htm
9. http://ilmukomputer.org/wp-content/uploads/2012/04/dahlan-excel-P.Teg-20121.pdf
10. http://ehe.pitt.edu/ojs/index.php/ehe/article/view/48
11. en.wikipedia.org/wiki/Active_learning
12. cit.duke.edu › Get Ideas › Teaching StrategiesT
13. w3.gre.ac.uk/~bj61/talessi/atl.html
14. www.calstatela.edu/dept/chem/.../Active/main.html